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ISSUE BRIEF

This document is based on research performed by FPL Group in collaboration with The Brattle Group.

U.S. CLIMATE POLICY: PRICING CARBON

PRESERVING THE ENVIRONMENT PROTECTING THE ECONOMY

This paper is based on research performed by FPL Group in collaboration with The Brattle Group, an independent economic consulting firm. That research involved in-depth empirical analyses of potential CO_2 policy approaches and their impacts on emissions, the economy, and our energy system, with special attention to the electric industry. The Appendix contains an overview of those analyses and results. Additional detail on our research can be found in an accompanying technical paper by The Brattle Group, available at www.brattle.com/publications.

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EXECUTIVE SUMMARY

Sufficient evidence of human-induced climate change exists today to warrant global and national action to limit and reduce the introduction into the atmosphere of greenhouse gases (GHGs), particularly carbon dioxide (CO_2). We believe it is prudent for the U.S. Congress to take immediate steps to set the U.S. on a path to lower CO_2 emissions rather than continue the current "business as usual" approach. While the existing theoretical and empirical data do not warrant an emergency "crash reduction" approach, they do support establishing and maintaining a glide slope to constrain the aggregate output of greenhouse gases.

We believe that the most effective GHG policy will price carbon emissions throughout the economy and do so in a predictable fashion.[1] By internalizing the cost of carbon into the overall cost of all goods and services throughout the economy, the proper incentives and economic signals to reduce emissions will be created, without also introducing unnecessary economic burdens or distortions. If properly implemented, such a policy need result in little loss of overall economic output. However, we note that current CO_2 policy discussions often fail to acknowledge that the effectiveness of the policy (measured ultimately by the aggregate economic cost of achieving a given level of CO_2 emissions reduction) depends crucially on exactly how the price is determined and the policy implemented. Our analysis supports the conclusion that a market-based, economy-wide program that directly places a price on carbon emissions has the best prospect of achieving sensible environmental goals and maintaining economic growth.

Many of the proposed programs that employ a pure cap and trade approach risk causing substantial harm to the economy. Moreover, most cap and trade proposals include the allocation of some level of free allowances, virtually guaranteeing a "feeding frenzy" among companies jockeying for position to obtain the maximum number of allowances they can. The administrative challenges of implementing a pure cap and trade program in a fair and rational way are likely insurmountable.[2] Furthermore, the science of climate change does not permit the determination of a single level of emissions – or a single path to a steady state level of emissions – that will produce the best result for humanity, thus taking away the principle attraction of cap and trade, which is that the precise amount of emission reductions are in principle known.

A primary conclusion of our research is that directly imposing a price on CO_2 emissions that predictably, steadily and gradually escalates over time offers substantial practical advantages: (i) it supports the long-term capital deployment that will be needed to address emissions by avoiding the volatility in future CO_2 prices that is inherent in a cap and trade approach; (ii) it creates the right long-term signals and incentives to support environmental goals while avoiding immediate large distortions and frictional costs in the economy; and (iii) it allows the economy time and opportunity to find the most efficient ways of adapting to rising CO_2 prices. Even as it does this, a properly structured fee will also automatically generate the resources that will be needed to: (i) support funding for the increased levels of basic R&D which will be needed to expeditiously develop new CO_2 abatement and control technologies; (ii) provide transitional assistance for economically disadvantaged end consumers; and (iii) preserve the competitive position of U.S.-based companies that compete in markets open to foreign competition that is not bearing an equivalent burden of CO_2 reduction ("leveling the playing field").

The program should be:

- Mandatory;
- Market-based;
- Economy-wide, applied upstream;
- Phased in gradually with a predictable, long-term CO_2 price trajectory;
- Free of large transitional protections; and
- Revenue neutral, returning revenues to the economy.

Our research suggests that a CO_2 price that starts at about $10/ton and increases at an annual rate of roughly $2/ton should be substantial enough to influence investment and consumption decisions, thereby reducing emissions, encouraging conservation, promoting efficiency, and stimulating technology and innovation, but not so great as to burden the economy unnecessarily.

We conclude that the goals of emissions reductions are met best with a directly imposed CO_2 price or fee. However, we also suggest that a modified cap and trade program which incorporates a price ceiling and floor and auctions all of the allowances, while more complex and less attractive than the direct fee approach, could offer similar benefits, providing confidence in long-term greenhouse gas reductions and price stability to protect the economy.

DIMENSIONS OF A CO_2 POLICY

The goals of a CO_2 policy should be to effectively reduce long-term CO_2 emissions, with minimum economic disruption and cost, in a way that is administratively efficient. Our research indicates that the following features are important to achieving these goals.

1) Mandatory

A voluntary program – one that neither imposes cost for CO_2 emissions nor rewards reductions – will give no incentives to change investment or consumption behaviors to reduce emissions, even among those otherwise willing to support a CO_2 control policy. The policy would be ultimately ineffective, and would prolong the current policy ambiguity and continue to complicate infrastructure planning.

2) Market-based

Market-based policies seek to capture the dynamics of the marketplace. There is general agreement that placing a price on CO_2 creates the incentive to reduce emissions efficiently.[3] The two fundamental market-based approaches to controlling emissions are: regulate quantity or regulate price. Both approaches put a price on CO_2: regulating quantity does so indirectly and imprecisely, the price approach does so directly and definitively.

A cap-based policy is a quantity approach. The allowed CO_2 quantity is set administratively, and applied to industry, to company and even to facility, based on target environmental goals and an estimated economic cost. A market for allowances then determines the price that is consistent with that quantity. Under a price approach, a fee sets the CO_2 price administratively at a level expected to induce emission reductions. The level of the fee is based on the expected cost of emissions avoidance, thus ensuring that it has "teeth." The market then determines the exact CO_2 emissions quantity that is consistent with that price. Both approaches can be effective. The quantity approach has been used in the past in the U.S. for controlling emissions of air pollutants. However, because of the particular characteristics of global climate change and the associated uncertainties in the science, the quantity approach is less attractive for addressing CO_2 reduction. As we explain, a pure quantity approach presents significant administrative complications and inefficiencies. A fee can be a simpler and ultimately more effective way to achieve the desired results.

3) Economy-wide

The use of energy from fossil fuels permeates the entire economy. There is no easy way to achieve the desired CO_2 reductions from any individual sector, as our analyses confirm. Sensible policy should spread the burden across all sources of CO_2 to achieve reductions as equitably and efficiently as possible.

Quite apart from being unfair, singling out one or several sectors of the economy for CO_2 control would be less effective than including all sectors of the economy. It would be inefficient and could not achieve as large a reduction. Applying a price to CO_2 throughout the economy provides an unbiased stimulus to all sectors to find cost-effective ways of reducing emissions. Since a ton of CO_2 emissions from one sector of the economy or one geographical region is no less a contributor to climate change than any other, this approach helps ensure the maximum reduction in emissions for the least economic impact.

As one of the nation's largest and most visible CO_2 emitters, the electric generation industry continues to be a prominent target of CO_2 policy. Until recently, it was widely assumed that the electric industry could provide substantial near-term CO_2 reductions relatively easily, largely by substituting natural gas for coal to fuel power plants. Recent large increases in the price of natural gas have fundamentally changed energy markets and rendered that expectation obsolete. Today and for the foreseeable future, large-scale CO_2 emissions reductions from the electric generating sector will require very substantial capital investments. The electric industry accounts for about 40 percent of U.S. CO_2 emissions. It would be inefficient and needlessly expensive to try to obtain all the desired reductions from this 40 percent without addressing the remaining 60 percent of emissions. The uncontrolled emissions of other sectors would continue to grow, and there could be uneconomic substitution of other fuels or processes for electricity, possibly even increasing CO_2 emissions overall and certainly offsetting some portion of the reductions obtained in the electric sector.

4) Upstream

A CO_2 price on the carbon content of fossil fuels should be applied at an "upstream" point where fossil fuels enter the economy. This would facilitate an economy-wide program and simplify administration. Just about 2,000 sources – coal mines and preparation plants, oil refineries and importers, natural gas pipelines and processing plants – would cover virtually all fossil fuels consumed in the U.S., applying the price only once to each unit of fuel.[4] The price of all fossil fuels would rise in proportion to their carbon content (combustion releases virtually all the carbon into the atmosphere as CO_2). Because CO_2 costs would be included in fuel prices, the price of all downstream goods would rise in proportion to the use of carbon-intensive fossil fuels in their manufacture and distribution.

It is important, however, to avoid raising the cost of fossil fuel uses that do not emit CO_2, such as the capture and permanent storage of CO_2 and petrochemicals used to make plastics. To that end, mechanisms such as credits, rebates or exemptions should be implemented for non-emitting uses.

5) Phased in

Introducing a CO_2 price into the economy and gradually increasing the price in pre-determined, measured increments balances two primary objectives: avoiding near-term economic disruption, and immediately influencing new investment and technology development toward low-carbon solutions.

While some might advocate a high initial CO_2 price to force near-term reductions, such an abrupt approach is inadvisable. It would likely shock the economy, necessitate short-term activities that cost more than longer-term solutions for the same reductions, and might impede needed investments in long-term research and solutions. It would invite companies, industries or regions to seek exceptions, undermining the program's goals. And the economic cost would risk political backlash from consumers – facing suddenly higher prices for energy and other goods, they would have had neither the time nor opportunity to change their energy use habits. In short, an abrupt policy would be unnecessarily costly, less effective and potentially self-defeating. In contrast, phasing in a CO_2 price will give all sectors of the economy both the time to react and advance awareness of how to react. Moreover, a high initial price is not warranted by the science of climate change. Everything we know about this subject shows that it is the long-term accumulation of CO_2 and other GHGs in the atmosphere that drive climate change effects. As the latest report of the IPCC demonstrates, the expected path of GHG concentrations for the next twenty or thirty years is insensitive to policy changes today. What matters is placing the global economy on a path towards substantial and sustained reductions over a long period of time.

The foreknowledge that CO_2 prices ultimately will reach a high level, but in a predictable way, will strongly encourage R&D and investment in carbon-abating technologies and projects. This would likely lead to greater long-run reductions, at lower cost.

6) Stable and predictable

A policy that creates a steadily escalating CO_2 price will offer stability and predictability to consumers, producers, regulators and investors alike. This will both protect the economy and encourage emission-reducing research and investment. Having a predictable escalating price that soon reaches levels where efficiency and low carbon technologies are economic will encourage long-term investment in those technologies.

If CO_2 emissions are fixed under a strict quantity-based policy, the price will be inherently uncertain and volatile, and potentially quite high.[5] Today, there are few if any technologies operating at commercial scale that can remove CO_2 from existing processes, and recent natural gas price increases make it very expensive to substitute lower-carbon gas for coal. If a fixed quantity cap were nonetheless enforced, the cost and price of CO_2 could skyrocket. The risk of a sharp price increase would be costly for existing CO_2-intensive processes, while the possibility that CO_2 price might drop precipitously later on would discourage long-term investments in emission-reducing technologies.

The risk of high or volatile CO_2 costs under a strict quantity-based policy would adversely affect utilities and their customers, in particular. Recent swings in the CO_2 price in Europe's Emissions Trading Scheme (a cap and trade program) have been substantial – even larger than the total variable cost of coal-fired power (see Appendix). Utilities, their customers and regulators will want to avoid this level of cost and price fluctuation, and the utility's resource planning would be much more effective if this uncertainty could be avoided.

7) Transitional protection

Transition protection should be limited and sparingly applied. It is important to retain the integrity of the CO_2 price signal; diluting the price signal for some segments of the economy would defeat the purpose of the program. By and large, a policy that puts a price on CO_2 will not require free allocations of allowances or other protection to indemnify producers. In a competitive industry, allocations will safeguard neither production nor jobs. Most energy producers, utilities, and energy-intensive industries will be forced to and will be able to incorporate most of their CO_2 costs into the price of their products, as our analyses have confirmed for electricity producers. The fact that end consumers will bear the economic burden makes it crucial that the overall system be structured for maximum economic efficiency – it will matter greatly to consumers that every ton of CO_2 that can be avoided at \$10/ton is eliminated before tackling the emissions that will cost \$20/ton to eliminate.

In the case of regulated utilities, a free allocation of allowances could compromise the program, artificially shielding some customers from CO_2 costs. This "protection" would eliminate one of the primary means for reducing CO_2 in the near-term – enlisting consumers to embrace conservation and efficiency to reduce demand and utilize energy more efficiently.

For unregulated producers, free allocations risk over-compensating producers for increased costs that may be passed through to customers via higher product prices, creating large and unfair windfalls that would rightly anger customers and politicians. Because the true incidence of CO_2 costs is very complex, allocations would virtually assure that the burdens would fall unevenly on the economy. (See Appendix.) Such windfalls are occurring now under Europe's cap and trade program because of its overly generous allowance allocations.

There is one clear exception to the general rule that the incidence of the CO_2 cost should be uniform. To the extent that not all countries impose comparable burdens on their economies, U.S.-based companies that compete against companies whose cost structures are not equivalently burdened should receive relief. This can be achieved by a variety of mechanisms, such as a rebate system analogous to those used by countries that impose value-added taxes. For products entering the U.S. from countries that do not include CO_2 costs in their exports, an equivalent CO_2 tariff could be imposed thus avoiding discrimination against American goods.

8) Revenue neutrality

If properly structured, and with continued technological development, a policy that employs a steadily rising CO_2 fee will eventually be largely self-extinguishing: in time, it will be more economic to eliminate CO_2 than to pay the fee. Thus, the revenue stream from the fee will be transitional – rising initially as the burden is imposed, and then eventually stabilizing and tailing away as CO_2 emissions are reduced. Similarly, the economic burden imposed is largely transitional. Over the long term, the economic cost of reducing CO_2 emissions is primarily driven by the costs of shifting the economy to a new equilibrium. Thus, the costs of adapting to lower CO_2 emissions profiles will be transitional – rising as the burden is imposed, and then eventually tailing away.

Because of this, it is crucial that a policy that prices CO_2 into the economy directly be revenue neutral: the revenue generated by the fee must be reinjected into the economy in a fashion that addresses the transitional economic costs (but that does not simply nullify the incentive imposed by adding the marginal cost of CO_2 into producers' and consumers' decision-making).

There are three important ways in which the revenue generated by a CO_2 fee should be used to support transition. First, in order to make the transition to a low or zero carbon-emitting economy as rapid as possible, revenues should be dedicated to leveraging CO_2 abatement by funding research, development and deployment and, possibly, financing investment in key low-carbon technologies. Second, since higher energy prices tend to be regressive, mechanisms to offset the effect on lower-income consumers must be developed. Third, as noted above, it will also be appropriate to use some of the revenues to offset any remaining negative impacts on particularly vulnerable industries – but only to the extent that they face genuine competition from entities whose cost structures do not properly reflect an equivalent cost of CO_2.

A PRICE FOR CO_2

Our research shows that a CO_2 price beginning at $10/ton of CO_2 and increasing by $2/ton each year would be both effective and manageable. In ten years, this CO_2 price would reach $30/ton, decreasing electric sector emissions by about 20 percent from what they would otherwise be, with further reductions continuing thereafter. (This estimate does not include the effect of technological substitution of low or zero-carbon generation in place of high-carbon conventional generators. Such substitution is likely to provide additional reductions, particularly in the longer term.) While this CO_2 price would achieve some early emission reductions, most importantly, it will alter investment and behavior patterns over decades to ensure substantial ongoing reductions well into the future. This is crucial – to effectively address climate change requires eliminating the large majority of current CO_2 emissions from the entire economy in the very long term. It is much less important to meet particular short-term emission targets; as the most recent IPCC report demonstrates, no realistic short-term policy change will have a meaningful impact on the short-term path of climate change.

Our analyses show that CO_2 prices at these levels are manageable for the electric industry, even for coal-based utilities. The current utility business model remains viable without substantial free allocations of allowances or other protections. In fact, large allocations are likely to be counterproductive, since they would unfairly insulate select groups of consumers from the CO_2 cost and inhibit energy efficiency and conservation, while potentially creating windfalls for the allowance recipients.

The proposed level of CO_2 price would also be manageable for other energy sectors. An initial $10/ton CO_2 price would increase energy costs across the board. (Of course, this would be the result of any CO_2 pricing program, including cap and trade.) Home heating costs would increase by about $3 per month for the average residential natural gas household, or $5 per month for oil-heated households. Gasoline prices would rise by about 10 cents per gallon. Electricity prices would increase by about 0.5 cent to one cent per kWh, roughly 10% of average retail rates. These increases are within the range of recent commodity price volatility, and further increases would be phased in gradually over a number of years. These energy price impacts can be made more tolerable if they are offset by the return of some portion of program revenues to consumers, which will provide meaningful assistance to lower income consumers without affecting incentives to conserve at the margin.

While the proper starting level and escalation rate of a CO_2 price can and certainly will be debated, we believe these are the right program attributes and approximately the right CO_2 price trajectory to strike the necessary balance between attaining early and sustained emission reductions while avoiding undue economic risk and harm.

While we focus on U.S. policy, we recognize that it is crucial to gain international cooperation in reducing emissions. A promising approach is to place an equivalent tariff on imports from countries lacking a carbon policy, and rebate the tariff on exports to such countries. A U.S. policy like this will send a clear signal from the world's largest consuming nation that a comparable CO_2 policy is required for doing business with the U.S., and may serve as a catalyst for broader international programs. Another key benefit is that it will preserve American jobs and competitiveness, because it avoids "offshoring" carbon-intensive industries.

IMPLEMENTATION

A CO_2 Fee

Both the fee approach suggested here, and cap-and-trade proposals more commonly promoted, have the potential to be effective.[6] Both harness market forces to bring about changes in our energy infrastructure and behavior and reduce CO_2 emissions. Nevertheless, our analyses show clear advantages to the fee approach for addressing the specific issues associated with global climate change. A CO_2 fee that increases predictably provides a foreseeable and certain CO_2 price, offering consumers and industry alike greater stability in energy prices. It avoids the uncertainty and price volatility of allowance prices under cap-and-trade, where fixing the quantity actually forces the price to fluctuate. In fact, a CO_2 fee eliminates CO_2 price uncertainty, further encouraging low-carbon technologies and offering greater economic protection.

A CO_2 fee puts the United States on an economically sustainable path to long-term CO_2 reductions. To a greater extent than a cap, the fee's predictability will encourage long-term investment in efficiency and low-carbon energy technologies. A fee could induce more CO_2 reductions than expected if carbon-reducing solutions were to become economic more quickly, while a cap gives no incentive to reduce emissions below the cap. The consistent escalation of the fee ensures that it will soon reach levels that promote CO_2 reductions, increasing the likelihood of actually achieving desired reductions, with only modest uncertainty as to the precise timing.

This fee proposal does not offer a way for producers to simply buy their way out of reducing CO_2. A persistently low fee might do that, but the increasing fee proposed here quickly reaches a level that gives strong incentives for CO_2 reduction. It would be clear from the outset that the fee would reach $30/ton of CO_2 in ten years. At about this level it is widely believed that large-scale low-and zero-carbon technologies, such as CO_2 sequestration and perhaps nuclear generation, would become economically viable. In fact, over the long term the program should be largely self-extinguishing, since the costs will eventually rise to levels that make it more economic to avoid the emission of essentially all man-made CO_2 than to pay the fee.

The price stability of a fee also protects the economy. An initial fee of $10/ton limits near-term economic disruption and gives producers and consumers years to anticipate and adapt to the higher CO_2 prices to come. This allows for efficient use and the ultimate re-deployment of existing capital stock, whereas an arbitrary volume target risks making large portions of the nation's capital investment obsolete, imposing significant, unnecessary economic burdens, while simultaneously missing relatively inexpensive reductions of CO_2 that consumers could make through conservation. As shown above, the impacts on fossil fuel prices in the near term will be manageable.

Not a tax?

While the fee approach offers significant economic and practical benefits, it will surely be subject to the political disadvantage of being characterized as a tax. That it is very different from a tax will not stop the critics from mischaracterizing it, nor from ignoring the fact that a pure cap and trade program, which will likely impose higher costs than a fee, is administratively cumbersome and is less effective. If the costs for CO_2 control and reduction are to be imposed on the American economy, care should be taken that this burden be imposed fairly, is the least costly, most efficient and most effective to achieve meaningful reductions.

Taxes by their nature are designed to raise revenue to fund government activities. Taxes are politically unpopular particularly when applied to broad, desirable economic activities (e.g., earning income or making profits) and because they are intentionally difficult to avoid. A CO_2 fee shares neither of these characteristics. First, over the long term a CO_2 fee is highly avoidable – in fact the fundamental long-term goal of the program is to prompt consumers and producers to avoid the fee by reducing and ultimately eliminating most CO_2 emitting activities. Second, the fee is not intended or structured to support general government activities, and in fact to be effective it must be excluded from the government's sources of general revenue. Revenue-neutrality, a key feature of the policy, ensures that the revenues are recycled directly into the economy in ways that mitigate the short-term transitional economic burdens of shifting the economy to a new, low CO_2 emissions path. Over the longer term, as noted above, the program should be essentially self-extinguishing.

Modified Cap and Trade?

Most CO_2 policies, whether existing or new programs (e.g., the EU ETS, California's Global Warming Solutions Act, the Regional Greenhouse Gas Initiative in the Northeast) or legislative proposals, rely on a cap and trade structure. The cap and trade approach establishes a total emissions cap and distributes a corresponding quantity of emission allowances, usually by free allocation, but sometimes by auction. Allowances are freely tradable, establishing a market price for the right to emit CO_2. The cap and trade mechanism has been very successful in reducing SO_2 in the U.S., which explains much of its popularity as an environmental policy mechanism. However, a cap and trade system, at least as typically structured, would not be well suited to control CO_2 emissions, for several reasons. A strict quantity cap can result in high and/or volatile CO_2 prices, creating risk for the economy and potentially discouraging needed investment in low-carbon alternatives. Pure cap and trade usually involves large free allocations of allowances, which are unnecessary in the case of CO_2, as noted earlier, and can create large windfalls. Free allocations protect emitters from reducing their emissions; they also discourage efficiency and conservation, which provide some of the best opportunities for near-term CO_2 reductions. And most cap and trade systems are applied to a small number of major sources, rather than economy-wide. Any cap and trade system for CO_2 will be enormously complex to administer and will surely set off a "feeding frenzy" among affected entities scrambling to protect their existing economic positions or better their future positions.

Nevertheless, it is possible to structure a cap and trade program to mitigate, though not eliminate, these problems, and it will be very important to do so if a cap-based policy is favored. First, a price ceiling and floor should be used to bound the extremes of CO_2 price and limit price volatility. This combines price and quantity mechanisms, allowing the price to fluctuate with market conditions within limits, and offers most of the advantages of CO_2 price stability. A price ceiling, sometimes called a "safety valve," would prevent the CO_2 price from exceeding a given level by creating additional allowances (essentially relaxing the quantity cap) if necessary to keep the price from getting too high. This protects the economy and limits the financial exposure of businesses, consumers and existing infrastructure. Similarly, a price floor prevents the price from falling too low, ensuring an attractive market for low-carbon technologies, encouraging their development and deployment.

A price ceiling and floor that brackets the desired carbon fee trajectory, with both floor and ceiling increasing gradually and predictably over time, would allow a CO_2 cap program to set a market price that both protects the economy and encourages no or low-carbon investment. The allowable "band" of CO_2 price between the floor and ceiling should be narrow enough to maintain the benefits of a reasonably predictable price but broad enough to encourage secondary trading within the band and forestall efforts to routinely relax the ceiling or floor.

Again, our research has shown that utilities do not need large allocations. A cap and trade program without large free allocations should auction the allowances. Auction revenues should be employed as with the carbon fee approach.

Whether implemented through a properly structured cap and trade program, or through a CO_2 fee, a policy that creates an escalating CO_2 price, starting from a meaningful level and increasing predictably, will have substantial advantages for both the environment and the economy over the cap and trade approaches currently under discussion.

CONCLUSION

To effectively control GHG emissions, a CO_2 control policy must persuade producers and consumers to produce and use less CO_2. It is generally understood by economists and others that placing a price on CO_2 will induce consumers to demand products and services that produce less CO_2 and require providers to manufacture products and generate energy with lower CO_2 emissions.

The way that a CO_2 price is implemented, however, is crucial. The initial introduction of a CO_2 price must be at a level that does not unnecessarily burden or disrupt the economy and which increases gradually to allow the economy to absorb the price without disruption or dislocation and to permit both consumers and producers sufficient time and opportunity to adjust to the new and higher price of CO_2. The escalation of the price must be predictable and aggressive enough to provide secure long-term price signals that will encourage and support the large, long-term capital deployments that will be needed if the economy is to move over time to a new, low CO_2 emissions profile.

Our analyses show that instituting a CO_2 fee with a gradually escalating price will provide an appropriate price signal to producers and consumers to reduce emissions. For industrial firms with long-planning horizons, it will provide critical stability and predictability; among producers and consumers it will encourage efficiency and conservation; for the new technologies needed to reduce CO_2 emissions, it will provide resources to support research and development and deployment. While a CO_2 fee is the most effective and efficient policy, it may be possible to modify a cap and trade program to produce roughly similar benefits, albeit not as readily or as efficiently, by incorporating a price ceiling and floor and by auctioning allowances.

Most important is to:

a) Promptly introduce a program that will begin a steady and sustainable reduction in U.S. CO_2 emissions;
b) Use market forces to reward lower carbon production and consumption;
c) Promote the research, development and deployment of low-carbon technologies
d) Encourage sensible long-term capital investment decisions through certain and stable prices for CO_2.

Our market economy has great difficulty assigning a current price to the long-term cost of CO_2 emissions. Congress can and should intervene in the economy solely to the extent of assigning a price profile to CO_2. It is less important that this price profile be the economically "optimal" one than that it begin at moderate but meaningful levels and then escalate predictably over a long period of time. Then, markets, consumers and producers can respond to this strong price signal and bring the substantial benefits of American ingenuity, market discipline and entrepreneurial creativity to controlling CO_2. The most efficient and effective way for Congress to intervene is with a carbon fee. Because a CO_2 fee is the least-cost, highest-benefit alternative, it merits discussion and consideration along with other GHG control proposals.

The policy considerations and the empirical evidence and analysis presented in this paper support a fee approach to controlling CO_2. We hope that this paper will stimulate broad discussion of these ideas and facilitate timely and sensible policy action to address CO_2 emissions and climate change

Notes:

1. This discussion focuses on CO_2, but of course the policy should also be extended to cover other greenhouse gases such as nitrous oxide and methane.
2. See Robert J Shapiro, Addressing the Risks of Climate Change: The Environmental Effectiveness and Economic Efficiency of Emissions Caps and Tradable Permits, Compared to Carbon Taxes, The American Consumer Institute, February 2007, at www.theamericanconsumer.org.
3. See, e.g., Phil Izzo, "Is It Time for a New Tax on Energy?" *The Wall Street Journal,* February 9, 2007.
4. See Tim Hargrave, U.S. Carbon Emissions Trading: Description of an Upstream Approach, Center for Clean Air Policy, Washington, DC, 1998.
5. See William D. Nordhaus, After Kyoto: Alternative Mechanisms to Control Global Warming, Yale University, December 9, 2005.
6. See CBO Issue Brief: Limiting Carbon Dioxide Emissions: Prices Versus Caps, Congressional Budget Office, March 15, 2005.

APPENDIX

This Appendix summarizes a number of the important analytic findings and resulting policy conclusions from joint research by FPL Group and The Brattle Group. A more thorough discussion of the methods used in those analyses and the technical details of these issues can be found in an accompanying technical paper by The Brattle Group, available at www.brattle.com/publications.

A. Effects on the Economy, Consumers and Other Industries

A.1 A modest but gradually escalating CO_2 price would entail a manageable burden on the economy as a whole.

Based on current U.S. greenhouse gas emissions of almost 7 billion tons (CO_2 equivalents), a CO_2 price of $10/ton corresponds to direct annual revenues of about $70 billion. This is a large amount in absolute terms, but a manageable share of the economy – about 0.5% of GDP – and the bulk of the revenues would be returned directly to the economy. A $10/ton CO_2 price would increase the cost of home heating by about $3 per month for the average residential natural gas household, or $5 per month for oil-heated households, while the price of gasoline would rise by 10¢ per gallon. Electricity prices would increase by 0.5-1¢/kWh. These increases are within the range of recent commodity price volatility, and further increases would be phased in gradually over a number of years.

A.2 Much of the CO_2 price effect will be reflected in goods and services.

Direct consumer energy usage in the U.S. accounts for less than half of total CO_2 output; most energy is consumed indirectly in the energy content of goods and services. Residential electric consumption accounts for only about 15% of total CO_2 emissions. This means that much of the CO_2 cost will appear indirectly in higher prices of other goods and services, rather than primarily through the increased cost of fuels and electricity. Lower income consumers are hit harder by rising energy costs; thus they will be affected disproportionately by a CO_2 control policy, whatever its form.

The consumer impact of this policy is one strong reason to insist that the program be revenue-neutral to government. Revenues collected should not be used to fund general government operations. Addressing the impact on low income consumers should be an integral part of the overall CO_2 reduction policy.

A.3 Some compensation may be needed to protect energy-intensive industries subject to import competition when the CO_2 price becomes high, unless foreign countries (particularly developing nations) adopt similar CO_2 policies.

A domestic price for CO_2 may raise the production costs of energy-intensive domestic industries, such as primary metals, chemicals and paper, impairing their ability to compete in domestic and foreign markets with international producers that do not face CO_2 costs. Higher CO_2 prices could push production of energy-intensive goods offshore to countries without comparable CO_2 policies, inducing needless economic harm while frustrating the intent of the CO_2 policy. Protections for some vulnerable industries may be warranted, but direct allocations of allowances are unlikely to have the desired effect. One environmentally and economically promising approach to address these problems would be to use "border tax adjustments" (BTA), where the additional costs of a domestic CO_2 price would be rebated to an exporting manufacturer, while a tariff comparable to the CO_2 price would be imposed on imported products, to the extent they are not already subject to comparable CO_2 controls. It is often acceptable under trade agreements to make certain types of border tax adjustments to counteract the effect of differences in domestic and foreign taxation. The advantages of border tax adjustments would need to be weighed against the administrative burden involved, as well as potential trade impacts.

A.4 A cap and trade program risks substantial CO_2 price uncertainty and volatility, absent mechanisms to limit the extremes of CO_2 price.

The European experience with cap and trade since the start of the Emissions Trading Scheme (EU ETS) in 2005 has shown that CO_2 prices under allowance trading can be quite volatile, as shown in Figure 1. ETS CO_2 prices started initially around €7/ton and increased to a high of nearly €30/ton. After several months of relative stability in the €20-25/ton range, the CO_2 price increased for a time and then collapsed within a few days to around €11/ton in early May 2006. After a temporary and partial rebound, it has subsequently fallen to under €1/ton. This fall is widely attributed to the allocation of excess allowances.

Figure 1: European CO_2 prices have shown marked volatility.

This level of CO_2 price volatility can make planning quite difficult. For a typical efficient coal plant, a variation in CO_2 price of €15/ton ($19/ton at the current exchange rate) corresponds to a change of about $19/MWh in operating costs. This is as large as the cost of fuel for many plants. Even for an efficient gas-fired combined cycle plant, this change in CO_2 price affects operating costs by $8/MWh. A price ceiling and floor will give greater confidence in CO_2 price, protecting the economy from very high prices and encouraging carbon-reducing investments by preventing very low prices. A fee-based policy could eliminate CO_2 price uncertainty altogether.

B. Analysis of Electric Industry impacts

The CO_2 price trajectory proposed here would not be disruptive to the electric industry, but it would catalyze structural changes quite soon. The industry's basic business model would remain intact, with existing assets retaining most of their value and with no abrupt, intolerable, or unmitigatable impacts on customers. A gradually escalating CO_2 price would give the necessary incentive and the time for conservation and carbon-abating technologies to be substituted for existing infrastructure, without threat to system reliability. This phased approach avoids the risk of quickly making a large portion of the generation base uneconomic in the early years of the program, while still ensuring that the technological transition will begin promptly.

B.1 The electric industry cannot provide substantial low-cost reductions in CO_2 emissions in the near future.

Substantial and rapid CO_2 reductions from the electric industry could have been reasonably expected in the mid-1990s, when the price of natural gas was below $3/MMBtu and new natural gas combined cycle plants were far cheaper to build and operate than coal plants. In such circumstances, the imposition of a moderate CO_2 price would have eliminated a great deal of CO_2 emissions simply through fuel switching – dispatching existing and new gas-fired plants more, and coal plants less. But with current gas prices at well over twice the levels of the 1990s, coal-fired generation is now substantially more economic than natural gas. Even a $30/ton CO_2 price (which would be reached in ten years at the proposed escalation rate) would not make gas more economic than efficient, existing coal-fired generators. As Figure 2 shows, with natural gas at $3, a small CO_2 price ($0-5/ton) would have made an efficient gas-fired combined cycle plant more economical than many coal plants. With gas around $7 now, a CO_2 price of $35-55/ton is needed to induce substantial fuel switching. Simulation modeling of the Eastern Interconnection confirms that the CO_2 price would need to get to around $30/ton to begin to induce substantial fuel switching at current gas prices; this would cause electric sector CO_2 reductions of about 8%.

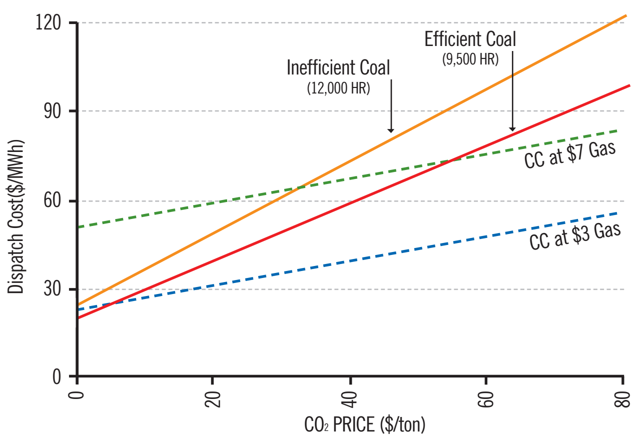

Figure 2: With high gas prices, a CO_2 price of $30/ton or more is needed to make existing gas-fired power plants more economic to operate than coal-fired plants.

B.2 Pricing carbon will raise the average cost and market price of electricity, but the attendant increases in customer bills will not be unmanageable – particularly if offset by end-use efficiency and conservation.

In most of the U.S., coal and natural gas-fired plants make up the majority of the total generation and an even a greater percentage of the generation on the margin, i.e., determining prices in competitive wholesale markets. As a result, the average and marginal cost of power – i.e., regulated cost-based rates and competitive market-based prices – are affected comparably by CO_2 prices, rising roughly $5-10/MWh in response to a $10/ton CO_2 price, as illustrated in Figures 3 and 4. Regions with the larger absolute and percentage increases tend to be those where rates are lower than average presently, due to the dominance of relatively inexpensive coal-fired generation. These estimated cost and price increases include only the direct effects of fuel switching, and not indirect changes like demand response, which partially mitigate the cost and price effects. A policy that phases in a CO_2 price to reach $30/ton over 10 years translates to an annual increase of about 0.2¢/kWh (2.5% of the current average retail price) or less – certainly not insignificant, but moderate compared to recent rate increases that have been driven by higher fuel costs. Cost and price increases are an expected and intended effect of a CO_2 control policy. The policy's goal should be to discourage activities that emit CO_2 and to encourage the development and substitution of technologies that emit less carbon.

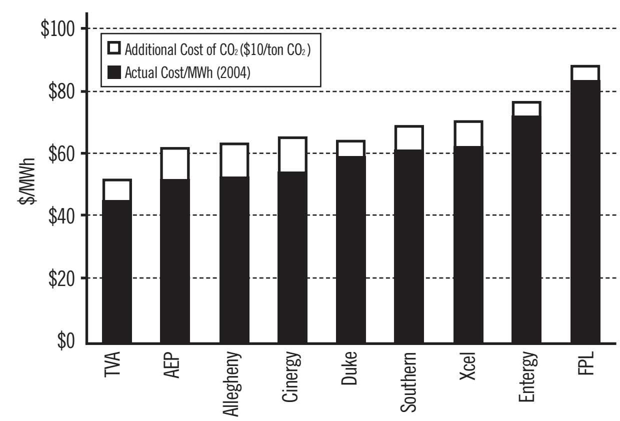

Figure 3: The average cost of power increases by $5-10/MWh with $10/ton CO_2 (selected utilities shown).

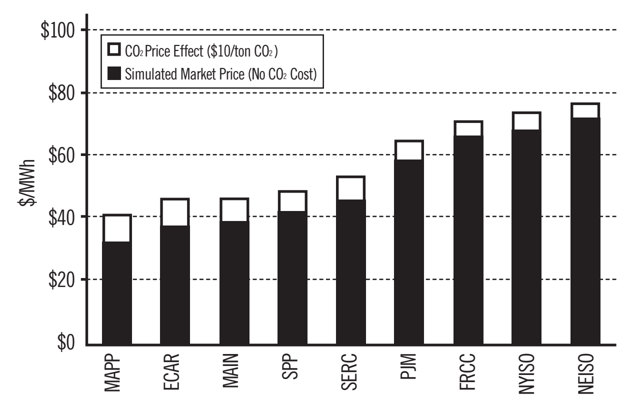

Figure 4: Competitive market prices also increase by $5-10/MWh under $10/ton CO_2 (simulated regional results).

B.3 Since there is limited potential for fuel-switching, most near-term CO_2 reduction in the electric sector must come from reducing demand and in the longer term, substituting lower-carbon technologies.

Significant conservation is likely to occur in response to progressive CO_2 price increases. A CO_2 price of $30/ton in ten years would reduce electric demand by 5-10%, leading to an 11% cut in electric sector CO_2 emissions. This is in addition to the 8% reduction expected from fuel switching. Still more reductions would come in the longer term from the adoption of less carbon-intensive technologies for generation additions. If a phased-in CO_2 policy like the one considered here is implemented, gas-fired capacity would again be competitive with traditional coal-fired capacity for generation expansion, and very low-carbon technologies such as nuclear and integrated gasification combined cycle with carbon capture and sequestration would hopefully become economic for future generations of capacity expansion. Phasing in the CO_2 price will mean smaller emission reductions initially, of course, but potentially greater reductions in the longer term as the CO_2 price continues to rise. As low carbon technologies become available, they will begin to penetrate the generation fleet, ultimately replacing traditional coal-fired plants for capacity expansion. Coal technologies will dramatically improve, given a clear economic signal of what that will be worth. (See, e.g., Future Carbon Regulations and Current Investments in Alternative Coal-Fired Power Plant Designs, R. Sekar, et al., Report No. 129, MIT Joint Program on the Science and Policy of Global Change, Dec 2005.)

B.4 Traditional coal-fired generators remain cost-effective for many years, even with a strong CO_2 control policy.

Current high natural gas prices have made coal plants very profitable, and traditional coal-fired generation will continue to be a significant part of the U.S. electricity supply mix for some time to come, even under a strong CO_2 policy. Our analysis shows that almost all existing coal capacity would remain viable until CO_2 prices get quite high, many years into the future under a phased-in program. At that point, older and less efficient coal-fired plants will start to be phased out as higher CO_2 costs make them uneconomical, but the newest and most efficient coal plants will continue to be viable. For plants operating in deregulated markets, imposing a CO_2 price would cause wholesale electricity prices to increase to levels that will partially (often almost entirely) compensate for the increase in coal plants' operating costs. Coal plants under cost-based regulation would still be economic to operate and would thus recover their costs in rates. The continued viability of the coal fleet also means that the proposed phased-in CO_2 price would not threaten system reliability, as it would only slowly encourage the retirement of the least-efficient coal plants.

B.5 A CO_2 control policy does not create a need for financial indemnification of utilities (e.g., via free allocation of allowances).

The electric industry is not vulnerable to competition from imports that are exempt from CO_2 costs, nor are there ready substitutes for most electricity uses. The financial performance of regulated cost-of-service utilities is mostly protected from CO_2 price increases, since regulators would generally pass additional costs through to customers in increased rates and utilities would have time to partially mitigate their exposure under a phased-in program. Figure 3 above showed that operating cost increases would be about $5-10/MWh in response to a $10/ton CO_2 price. Market simulation of the Eastern Interconnect indicates that competitive market prices increase about the same amount (Figure 4 above), so that in a fully deregulated market generators would, on average, also recover their increased costs. This is not uniformly true; some generators who are more CO_2-intensive than their regional market would fare less well if they are not under cost-recovery regulation.

Figure 5 shows the simulated effect of a $10/ton CO_2 price on the gross margins of generators in the Eastern Interconnect (revenues minus total variable costs, with no demand response), assuming that all operate in competitive generation markets. As expected, the potential competitive financial effect is closely correlated with a generator's overall CO_2 intensity, though also depends on relative CO_2 intensity compared with price-setting generation in the region. A key result is that for even the worst affected generators, to offset their potential losses would require free allocations equal to less than 30% of their total emissions, and more than half the generators would actually benefit without any free allocations. Thus, large free allocations are not necessary to protect generators' financial health, and would create unnecessary financial windfalls. The European experience has shown that large allocations, which were made under the EU ETS, lead to large windfalls for producers. For example, the UK regulator estimated that the windfall to UK generators alone could cause a wealth transfer of as much as £19 billion over the eight years encompassing Phases 1 and 2 of the EU ETS (this estimate was based on a CO_2 price of €25/ton; it would be lower at the current price, but still substantial). See "Our Energy Challenge": OFGEM's Response, Office of Gas and Electricity Markets, May 2006.

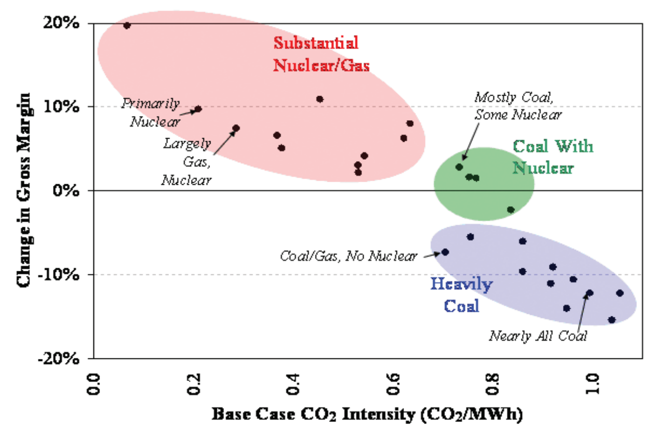

Figure 5: Effect of CO_2 price on generator margins (if all were deregulated) is closely related to carbon intensity. (Simulated results for Eastern Interconnect generation fleets; no free allocations.)

Understandably, some regulated utilities may desire allowance allocations in order to protect their customers, rather than for themselves directly. While some consumer protections are certainly warranted (especially for lower-income customers), electric utilities are not well placed to provide such protection, for several reasons. First, in an economy-wide program where electricity is responsible for a small fraction of total consumer impacts (residential electricity accounts for only 15% of total CO_2), it will be difficult or impossible to achieve fair and equitable protection for consumers via their electricity suppliers. Second, this is further complicated by the fact that some consumers are served by regulated, vertically integrated utilities, and others get their power from deregulated generators. It would be difficult to make allowance allocations to generators (or even to distribution companies) that would translate to equitable protection for all consumers. Finally, it is important that electricity consumers, like consumers of other energy forms, see the effect of CO_2 price, to preserve incentives for cost-effective conservation and efficiency measures that will contribute to emission reductions. Other, broader forms of consumer protection – e.g., the return of program revenues directly to consumers – would offset the income loss due to higher energy prices while preserving the price signal. There is a strong role for utilities in this regard, with energy conservation and technology adoption programs funded by CO_2 policy revenues.